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that *Actinococcus subcutaneus* may really be "an asexual generation of *Phyllophora Brodiaei*, growing parasitically on the sexual generation." Darbishire (*loc. cit.*) succeeded in showing that the thallus of *Actinococcus subcutaneus* develops from a spore that enters the thallus of the male plant of *Phyllophora Brodiaei* through an antheridial ostiole, but he was not able to discover whence the spore came or whether it was a tetraspore or a carpospore.

Polysiphonia urceolata formosa (Suhr) J. Ag. Sterile.

Rhodomela subfusca (Woodw.) Ag. Tetrasporic.

Ceramium rubrum (Huds.) Ag. Tetrasporic.

Rhododermis Georgii (Batt.) Collins. Forming cushions on the margins of *Zostera* leaves, with sporangia.

Corallina officinalis L.

On March 7, *Pylaiella littoralis* (L.) Kjellm., *Polysiphonia nigrescens* (Dillw.) Grev., and *Epilithon membranaceum* (Esp.) Heyd. were added to the foregoing lists.

NEW YORK BOTANICAL GARDEN.

OCCURRENCE OF THE INDIAN PIPE (MONOTROPA UNIFLORA) IN A XEROPHYTIC HABITAT

BY EDWIN D. HULL

The Indian pipe (*Monotropa uniflora*) is considered one of the most mesophytic of our plants, and the habitat in which it grows is supposed to conform to its nature. The 7th edition of Gray's Manual gives the habitat of this species as, "Rich and dark woods." S. Coulter (1) says, "Indicative of rich soil." I have, however, found it growing sparingly on the oak dunes about Lake Michigan at Miller, Lake Co., Indiana, where it seems to be the only mesophyte in an otherwise distinctly xerophytic flora, at least so far as the vascular plants are concerned. The trees of this association, of which the black oak (*Quercus velutina*) far exceeds all the other species in abundance, stand some distance apart and permit considerable light to penetrate, so that the forest is decidedly open rather than dark. The undergrowth does not form a continuous mat, and there are numerous broad

patches of barren sand. Cowles (2) in 1899 described the ecology of these dunes, and showed conclusively that the flora is xerophytic. Coulter (1) listed the vascular plants of these oak dunes, totalling 43 species, all of which are of a xerophytic character. The nature of the situation is best shown by listing some of the most conspicuous and abundant plants contributing to the undergrowth. These are *Pteris aquilina*, *Lupinus perennis*, *Viola pedata lineariloba*, *Opuntia Rafinesquii*, *Vaccinium pennsylvanicum* and *Phlox pilosa*. The Indian pipe, not being abundant, seems to have been entirely overlooked by the numerous investigators of the sand dune flora. Its scarcity, however, may be due to other than edaphic causes. Coulter (1) reports it as widely distributed throughout Indiana, but not abundant, so it may be as common here as in more mesophytic areas in the state. This author listed the counties in which the plant has been found, but it seems not to have been reported from any of the counties bordering the lake, nor from any of the counties adjacent to these, although it doubtless occurs in all. I found at the above mentioned station September 15, 1912 a single clump of this species at the base of a black oak (*Quercus velutina*), consisting of three stalks, evidently of recent appearance, as the summit of the stems showed no tendency to become erect as is the case when the fruit matures. Stalks of the preceding year were also found. Early in October of the same year I found in a similar situation at Dune Park, a few miles east of Miller, another clump of these plants with the seeds nearly all shed. It is seen, therefore, that the aerial life of this species is very brief, doubtless of less than a month in duration, at least in this locality. While the plants found at Miller were somewhat dwarfed, the two dried stems before me measuring 11 and 12.5 cm., they are considerably above the minimum height, .5 dm., given in Gray's Manual.

It should be here noted that Coulter (1) reports the species as occasional on dry wooded hillsides in the southern counties of Indiana, and I have myself found it on the summits of dry oak covered hills in DeWitt Co., Illinois, where the plants are locally abundant. Such habitats, while probably not nearly so xero-

phytic as the oak dunes of Lake Michigan, are not of an extreme mesophytic character by any means. I have noticed that in these Illinois plants the culmination of the flowering period is not reached until the latter part of August or early September, but the flowers do not come so late as in plants of the sand dunes. That the habitat, in DeWitt Co., at least, is more mesophytic, is indicated by the distribution of the xerophytic fern (*Pteris aquilina*) in that county. Here in the dunes this fern is associated with the oaks, but in the oak woods of DeWitt Co. it is entirely absent, occurring only on barren, exposed hills, the most xerophytic areas in the region. The situation in southern Indiana may be the same.

The late blooming, September 15, is also noteworthy. Coulter (1) gives the blooming period as extending from June to August, which is the exact time given in Gray's Manual. It is interesting that xerophitism, often so potent a factor in early blooming, seems to have a reverse effect on the flowering of this species.

To account for the occurrence of this mesophyte in a xerophytic area, there seems to me two theories which should be considered. One theory would be that some local condition, comparable to the usual mesophytic habitat of this species, exists. A second view would be that the plant is able to endure xerophytic conditions on account of its short aerial life, provided there is sufficient stable humus to enable the underground portion to persist from year to year. An alternative, of course, would be to consider the plant as a xerophyte, but there is no evidence to support such an assumption.

Of the two theories the second seems to be the more valid one. About the only evidence to support the first view is that apparently the plants are here subjected to rather severe conditions, as is shown by the scarcity and semi-dwarfness of the stems, these being also much blackened by the sun. But such evidence may be more apparent than real, for the plant is able to persist and ripen its seed as well here as elsewhere. To support the second view we have the evidence of late blooming, which seems to me very important. If a local condition existed, the plant would be expected to flower in its usual season. Cowles (2)

has shown that even in the open shifting sand between the oaks, a very xerophytic situation, such fungi as various species of *Geaster* and *Lycoperdon* occur. Plants like these can hardly be called xerophytes, but on the contrary are extremely mesophytic, the entire aerial life of the plant being of extremely brief duration. Otherwise the plants probably exist only as spores, the delicate mycelium being unable to withstand any severe or prolonged drought. Of similar habit are many desert plants, both annual and perennial, which spring up during wet seasons and persist in dry periods only underground, or as seeds. These plants, as pointed out by Schimper (3) possess no xerophytic structures, and would, therefore, be called mesophytes. Comparable in habit to these desert perennials, it seems to me, is the Indian pipe, although, unlike them, its activity must be confined to a definite period, on account of seasonal changes in temperature. The question might naturally be raised that if the plant is able to live in xerophytic habitats, it should also be found in the more exposed places, as are the fungi. But the peculiar short root system of this species would be exposed quickly by a shifting of the sand, even though slight, and the plant would necessarily perish. As I have stated, the fungi probably exist over severe periods in the form of spores, while the Indian pipe cannot produce fruit in a single season from the seed, in all probability, so that a stable soil is requisite.

It would seem, however, that the plant is confined to woodland habitats, whether mesophytic or otherwise. Sunlight, as is well-known, causes a blackening of the stems, and extreme sunlight would doubtless kill them. It is unlikely, therefore, that the plants could exist in the open. But given a degree of shade, it seems reasonable to suppose that they could exist in some of the most xerophytic places.

The late mid-September blooming, which seems to be the key to the persistence of the plant here, could be accounted for in the following manner. Fuller (4), who investigated the evaporating power of the air in its relation to the vegetation of the sand dunes, has shown that commencing about the first of September there is a decided drop in the rate of evaporation and this drop continues

during the greater part of the month, when the rate begins to rise on account of the trees shedding their foliage. By the latter part of September the rate of evaporation is at its lowest expression during the period under observation, namely, from May to October, inclusive. This low rate of September forms a striking contrast to the high rates of much of June and all of July and August, the usual flowering period of this species. It is during this period of low evaporation that the stems of the Indian pipe spring up, flower and mature their fruit.

From the above data it would seem that the Indian pipe is a mesophyte, but so far from being confined to mesophytic woods, is able to persist in decidedly xerophytic areas. It seems, however, to be confined to woods. This persistence is determined by the short aerial life of the plant, and not by the formation of any xerophytic structures.

CHICAGO, ILL.

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TWO NEW TERTIARY SPECIES OF TRAPA

BY EDWARD W. BERRY

The genus *Trapa*, formerly included in the family Onograceae, is now made the type and only genus of the Hydrocaryaceae (Trapaceae, Dumort, 1827). There are three existing species, all aquatics, and all confined to the Old World except for the naturalization of *Trapa natans* L., in New England and New York. The latter species is found irregularly scattered throughout central and southern Europe, its area of distribution being a contracting